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DISTRIBUTION AND CONSERVATION OF NANTUCKET SHADBUSH, *AMELANCHIER NANTUCKETENSIS* (ROSACEAE)

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ABSTRACT

Amelanchier nantucketensis, Nantucket shadbush, thought to be restricted to coastal Massachusetts and Long Island, New York, is now also known from Maine, Maryland, inland Massachusetts, New Hampshire, and Nova Scotia. Distribution is greater in part due to a wider circumscription of the species; *A. nantucketensis* intergrades with and therefore includes *A. stolonifera* f. *micropetala.* The 41 extant populations reported here each consist of up to 13 individuals, grow in early successional sites, and almost always occur with other *Amelanchier* species. Conservation at the state level is recommended for *A. nantucketensis,* which should be included in administrative rare plant lists. Protection of local populations would be best effected by controlling vegetation to maintain an early successional stage.

Key Words: *Amelanchier nantucketensis,* endemism, Maine, Nantucket, Nova Scotia, shadbush

INTRODUCTION

Setting priorities for conservation is problematic in clonal plants, yet conservation at some level is appropriate for a recognizable morph that is apparently stable (Holsinger, 1992). This is especially so if the morph has small, isolated populations and a clearly bounded geographic range, requires specialized habitat, depends on rare pollinators or dispersers, or supports a rare or unusually diverse fauna. Data regarding number and size of populations and ecology of species can be useful in determining whether a species is worthy of special consideration.

Amelanchier, the shadbushes, contains as many as 17 species and three named hybrids of shrubs and trees in eastern North America (Phipps et al., 1990). Most of these are widespread and poorly defined due in part to facultative agamospermy (asexual seed production), polyploidy, and hybridization (Campbell and Dickinson, 1990; Campbell and Wright, in press). A northeastern North American species of *Amelanchier* that has been characterized as a narrow endemic is *A. nantucketensis* Bickn., Nantucket shadbush, originally known only from Massachusetts coastal islands (Bicknell, 1911; Sorrie, 1987) and later from Long Island, New York. *Amelanchier nantucketensis* was in Category 2 of the

Federal Register of Endangered and Threatened Plant Species, indicating that formal listing required more knowledge about taxonomic status, geographic distribution, or threats. On February 28, 1996, the U.S. Department of the Interior Fish and Wildlife Service dropped Category 2 (Office of the Federal Register, 1996 February 28) because of uneven data quality and insufficient resources. Thus *Amelanchier nantucketensis* no longer has Federal status. *Amelanchier nantucketensis* was considered to be a hybrid by Gleason and Cronquist (1991). Standley (1992) noted the lack of information regarding the biology of this taxon.

Amelanchier nantucketensis has an unusual feature, andropetaly; this is a term we propose for the condition of petals bearing one or usually two microsporangia. Andropetals replace normal, sterile petals, are often narrower and shorter than sterile petals, and are ivory rather than white (Dibble, 1995). Andropetaly is evident in at least some flowers on an individual; however, not all petals on a plant bear pollen. This condition is also found in *A. stolonifera* Wieg. f. *micropetala* (Robins.) Rehd. (Fernald, 1950), where it was termed "staminody" by Weatherby (1916). Tiny, pollen-bearing petals are found also, though rarely, in *A. obovalis* (Michx.) Ashe, coastal shadbush. Andropetaly in *Amelanchier* is associated with a floral syndrome which is characterized by dense inflorescences, short pedicels, and small petals. A distinct component of the pollinator guild of solitary bees is attracted to andropetalous plants when compared to sympatric *Amelanchier* with normal petals. Possibly, the attraction to bees is not andropetaly so much as overall floral display in *A. nantucketensis* (Dibble, 1995).

Amelanchier nantucketensis and *A. stolonifera* f. *micropetala* were thought to differ in the amount of pubsecence on the ovary summit (Fernald, 1950), but this distinction is not consistent. *Amelanchier stolonifera* f. *micropetala* has therefore been merged into *A. nantucketensis* on the basis of six morphological characters (Dibble, 1995).

Historic collections of this more broadly defined species indicate that its range extends mostly along the coastal plain from northern Virginia to Maine. The Massachusetts Natural Heritage Endangered Species Program (MNHESP) has records for an estimated 30–40 small populations of *Amelanchier nantucketensis* on Nantucket, 12 on Martha's Vineyard, and 11 populations in five counties of inland Massachusetts and Cape Cod. Most of

these populations have been field-checked within the past 20 years. In Connecticut, four populations in three counties are recorded, but none are known to be extant. On Long Island, New York, at least three extant populations are known. Therefore, status as a narrow endemic is no longer appropriate for a species with such a large distribution, especially given nonspecificity of habitat in known locales.

Our objectives were to document geographic distribution and population size for *A. nantucketensis*. We also sought habitat features and ecological links or associations with rare pollinators that might be important to consider in planning a conservation strategy.

MATERIALS AND METHODS

This study involved a wide-ranging field survey of northeastern North American *Amelanchier* and included three visits to the type locality of *A. nantucketensis*. We collected and pressed specimens from 565 permanently marked plants including 62 individuals of *A. nantucketensis* from 38 populations. Field surveys in New England, Maryland, New Jersey, New Brunswick, Nova Scotia, the Gaspé Peninsula of Quebec, and the west coast of Newfoundland from 1990–94 concentrated on roadsides, watercourses, meadows, and other disturbed habitats. We regard a population to be an aggregation of individuals separated from any other aggregation by at least 0.5 km. Because *Amelanchier* plants are clonal and therefore often occur in clumps of stems, we made the assumption that one clump represents one individual. We counted clumps per population and number of stems per clump, estimated or measured plant height, and noted habitat features. Identification of an assumed genetic individual was based on at least 2 m physical separation between clumps of stems; we have not found rhizomes to exceed a length of 50 cm. This 2 m criterion does not account for the possibility that several genotypes may grow intermingled within a clump or that some "individuals" could be multicloned from agamospermy or fragments of former large clumps.

We located *Amelanchier* plants in flower and returned to the same stems to collect mature leaves and developing or mature fruits. At each population of *A. nantucketensis* we collected sam-

ples from all accessible sympatric *Amelanchier* morphs and identified them using several treatments of the genus (Wiegand, 1912; Jones, 1946; Fernald, 1950; Hinds, 1986; Gleason and Conquist, 1991). To assess recruitment, we searched for seedlings among mature ramets of *A. nantucketensis*. We noted evidence of herbivory, fungal infection, insect visits to flowers, and activity of dispersers where present.

We examined herbarium specimens at ACAD, BH, GH, NEBC, and NSAC (herbarium acronyms follow Holmgren et al., 1990) for *A. nantucketensis* from the type locality and elsewhere. Dibble (1995) reported additional information regarding morphology, cytology, megasporogenesis, and pollination ecology.

RESULTS AND DISCUSSION

Distribution and endemism

The geographic range of *A. nantucketensis* is greater than previously recognized; this increase is due to concerted effort in field surveys and to lumping *A. stolonifera* f. *micropetala* into *A. nantucketensis*. The range extends from Great Falls, Maryland (Ashe, 1944), along the coastal plain to Nova Scotia, with inland populations in northwestern Massachusetts and New Hampshire (both are montane habitats), and northwestern Maine on a high gravelly bank on the St. John River (Table 1, Figure 1). *Amelanchier* taxa exhibiting andropetaly were previously unknown in Canada (Scoggan, 1987). *Amelanchier nantucketensis* is apparently not limited to coastal plain communities.

North American *Amelanchier* contains numerous taxa of narrow geographic distribution. *Amelanchier lucida* Fern., for example, is limited to Nova Scotia (Fernald, 1948; Roland and Smith, 1969). Others include *A. amabilis* Wieg. (Fernald, 1950), *A. fernaldii* Wieg. (Wiegand, 1912), *A. huronensis* Wieg., *A. micronata* Nielsen, *A. interior* Nielsen (Nielsen, 1939), *A. gaspensis* (Wieg.) Fern. & Weatherby, *A. florida* Lindl., *A. cusickii* Fern., and *A. basalticola* Piper (Jones, 1946). In addition, we have identified several series of populations that are morphologically discrete and narrowly distributed in Maine or in Maine and New Brunswick (Dibble, 1995).

Some of these narrowly distributed taxa may be the product of

Table 1. Extant and historic (known prior to 1976) populations of *Amelanchier nantucketensis* that were visited for this study or reported to the authors, and estimated population size for each within about 50 m radius. Records for additional sites are kept at the Massachusetts Natural Heritage Endangered Species Program.

State/Province	County	Town	Number of populations: Historic	Number of populations: Extant	Population size (no. of individuals[a])	Year last seen
Connecticut	New London	Waterford	1	0	0	ca. 1975
Maine	Penobscot	Bangor		1	13	1994
Maine	Penobscot	Bradley		1	2	1993
Maine	Penobscot	Eddington		1	1	1993
Maine	Penobscot	Milford		1	1	1996
Maine	Penobscot	Old Town		1	6	1995
Maine	Penobscot	Orono		3	11	1994
Maine	Hancock	Ellsworth		3	5	1994
Maine	Hancock	Bar Harbor		1	9	1993
Maine	Aroostook	T12 R16 WELS	1	1	1	1995
Maine	Lincoln	Wiscasset		1	1	1991
Maryland	Montgomery	Great Falls	1	1	3	1993
Massachusetts	Nantucket	Nantucket	1	18	44	most: 1993
Massachusetts	Barnstable	Harwich		1	1	1990
Massachusetts	Barnstable	Hyannis		1	1	1991
Massachusetts	Berkshire	N. Adams[b]		1	1	1987
Massachusetts	Dukes	Edgartown		1	9	1992
New Hampshire	Carroll	N. Conway		1	10	1996
New York	Nassau	Montauk		1	9	1992
New York	Nassau	Shinnecock		1	4	1992
Nova Scotia	Shelburne	Jordan Bay	–	1	9	1992
	Totals	21	4	41	141	

[a] An "individual" may consist of one or more genotypes and is considered a discrete clump of stems separated by >2 m from other clumps.

[b] Specimens identified as *A. stolonifera* f. *micropetala*, Pamela B. Weatherbee, Williamstown, Berkshire Co., MA, 9 May 1987 No. 772 and 8 July 1987 No. 998; Summit, Pine Cobble Mt.—elev. ca. 800 m).

the interplay between hybridization and agamospermy. *Amelanchier* hybrids with at least one agamospermous parent are also agamospermous in the two cases that have been studied (Weber and Campbell, 1989; Campbell and Wright, in press). Agamospermy perpetuates hybrids and thus generates microspecies, se-

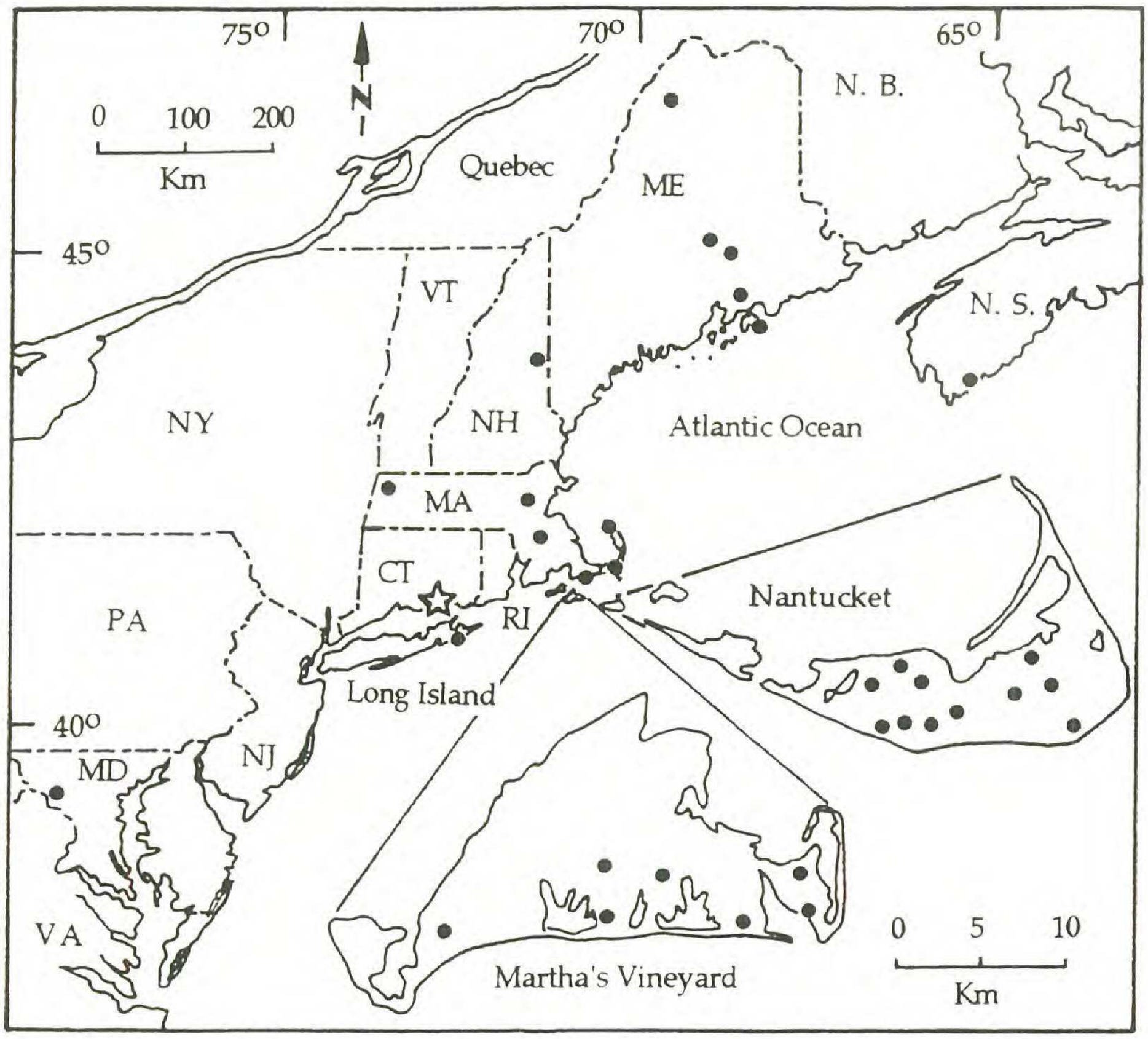

Figure 1. Geographic distribution of *Amelanchier nantucketensis*, with approximate extant (dots) and historic but presumed extirpated (star) locations. Multiple populations are represented by a single dot in some cases.

ries of populations derived from uniparental reproduction (Grant, 1981).

As a tetraploid agamosperm, *Amelanchier nantucketensis* (Dibble, 1995) may itself be of hybrid origin, as suggested by Gleason and Cronquist (1991); however, unambiguous identification of parental taxa has not been made. *Amelanchier nantucketensis* may participate in microspecies formation because it frequently grows with other *Amelanchier*, and in most cases there is overlap in flowering times. *Amelanchier* species and hybrids that grow with *A. nantucketensis* include *A. canadensis, A. stolonifera, A. laevis* Wieg., *A.* cf. *humilis* Wieg., and less commonly, *A. arborea* (Michx. f.) Fern., *A. bartramiana* (Tausch) M. Roemer, *A.* ×*neglecta* Eggl est., *A.* ×*intermedia* Spach, and a morph we tentatively identify as *A.* cf. *humilis* × *A. laevis*. The above list includes the first record of *A. stolonifera* on Nantucket. We have observed apparent

morphological intermediates between *A. nantucketensis* and *A. stolonifera* in some populations on Nantucket and in Orono, Maine (Dibble, 1995). The Orono population of *A. stolonifera* includes tetraploid agamosperms.

For most of the supposed narrowly distributed endemic *Amelanchier* species, taxonomic status and geographic distribution are uncertain and, in our experience, not fully determinable from herbarium specimens. Ideally, the status of these entities will be ascertained from detailed study of morphological and molecular variation, hybridization, ploidy, and reproductive biology. To date, extensive study of supposed rare *Amelanchier* taxa other than *A. nantucketensis* is lacking.

Population number and size

We visited 38 populations of *A. nantucketensis* for this study; locations of three others were brought to our attention (Table 1). Fourteen of these were unknown prior to 1990. Based on records kept by MNHESP, the total number of extant populations could exceed 80; the actual total depends on whether one considers occurrences within gene flow (i.e., pollen and seed dispersal) distance of others, as on Nantucket, to be populations or subpopulations. Determining the number of individuals at these populations is difficult in this rhizomatous shrub. Numerous stems (or apparent ramets) arise within 10–50 cm of each other, and presumed genets may be up to 10 m across. All populations we visited are small, usually with one or a few individuals each consisting of numerous stems. Populations with up to 13 individuals are known from Maine and Nantucket. One Maine population has since been extirpated by a construction project.

We found no small seedlings among the densely arranged mature ramets of *A. nantucketensis*. However, we observed young ramets growing at the center as well as near the edges of large clumps. These young ramets usually have large leaves compared to older ramets, suggesting they are sprouts from rhizomes rather than seedlings.

Habitat

The diversity of habitats occupied by *A. nantucketensis* is much greater than previously known. It grows in sand or loam or on

ledges, along roadsides, river and stream shores, in coastal heaths, and under powerlines. Rarely, it grows in early- to mid-successional forests dominated by *Quercus rubra* L., *Populus* spp., *Betula* spp., *Pinus strobus* L., and *Picea* spp., always within about 10 m of an opening. Occurrence in such habitats could depend on succession of the site. As with many *Amelanchier* species, *A. nantucketensis* has the greatest density of stems and the most prolific flowering and fruiting in sunny sites. Soil drainage may influence plant height, with mesic soils supporting taller plants.

Conservation aspects

Because *A. nantucketensis* is associated with ecotones and such habitats are often occupied by a higher diversity of organisms than are adjacent areas under closed canopies, the potential for ecological links between this colonizing plant and various opportunistic animals is relatively high. We found no rare arthropods associated with *A. nantucketensis,* but a multitude of invertebrates use this species as forage, breeding habitat, or as a domicile. We did not find any obligately species-specific invertebrates, and we observed similar associations among these animals and various other *Amelanchier* species (Dibble, 1995).

Examples of some animals associated with *Amelanchier nantucketensis* include more than 40 species of generalist solitary bees, which are probably the primary pollinators of this species (Dibble, 1995). Flowers are also visited by sawflies (Tenthredinidae), bee flies (Bombyliidae), flower flies (Syrphidae), moths and butterflies (Lepidoptera), and various beetles including dermestids (Dermestidae). Insect herbivores include leaf cutter bees (*Megachile* spp.), which use circular pieces of leaf to line their nests; weevils (Curculionidae); scale insects (Coccidae); aphids (Aphididae); and leaf miners (Agromyzidae). Ants (Formicidae), perhaps attracted by nectar, are ubiquitous on flowers and developing fruits; they eat styles, stamens, petals, sepals, and carpels. Crab spiders (Thomisidae) are camouflaged on flowers and capture visiting, small, solitary bees. Weevils mate on the plants during anthesis; then the females oviposit into the hypanthium; later the larvae consume developing *Amelanchier* embryos. Wounds created by weevils provide one entry for *Gymnosporangium* rust, the alternate host for which is *Juniperus*. This rust disfigures the fruits so that birds avoid these when foraging on

the plants, but viable seeds can develop within spermogonia-laden fruits (Dibble, unpubl. data). The fruits probably fall to the ground near the parent plant, which would allow seeds to germinate in a microsite to which the genotype is well-adapted. Dispersal is by birds and various mammals, and there is potential that seeds consumed on different but nearby species could be deposited together, germinate, and grow intermingled, adding to confusion of field observers.

All these associations are integral parts of a fully functioning ecosystem and represent a microcosm of ecological interactions in and around a host plant species. For conservation purposes, no link is dispensable given that we do not fully understand relationships between organisms. Although these associates of *A. nantucketensis* are mostly common, widely-distributed generalists, it is unknown whether this shadbush species would be adversely affected by loss or reduction in numbers of any of these animal and fungal species.

Listing at the state rather than Federal level is recommended for *A. nantucketensis* because it has more than 60 recently verified populations and a broad geographic range compared with narrow endemics listed as Federally Endangered. Although some state lists, such as Maine's (Dibble et al., 1989), provide no regulatory protection, recognition of rarity within the state could increase the likelihood that some *A. nantucketensis* populations will be protected voluntarily. Small populations and occurrence in habitats subject to frequent human disturbance or succession make *A. nantucketensis* susceptible to population extinction if development destroys habitat or if forests succeed open areas. In protected populations, woody vegetation should be monitored every 2–5 years and controlled by mowing or burning to maintain the early successional habitat conducive to persistence of *A. nantucketensis*.

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A line drawing of *Amelanchier nantucketensis* appears on the cover of Rhodora 95, 1993.